



# Rupantarita Prakritik Gas Company Limited

# Welcome



Subject : LNG Unloading Systems

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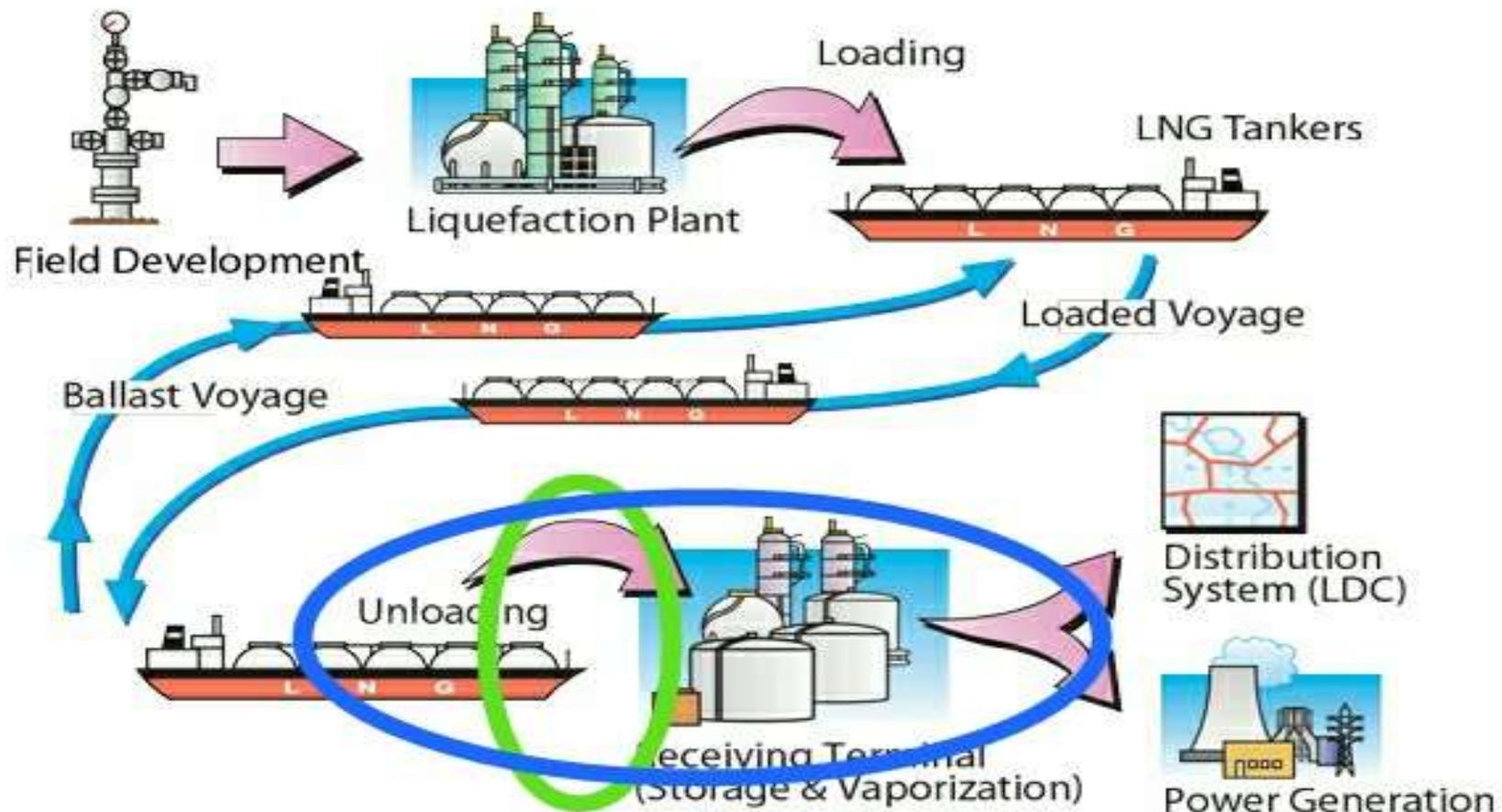
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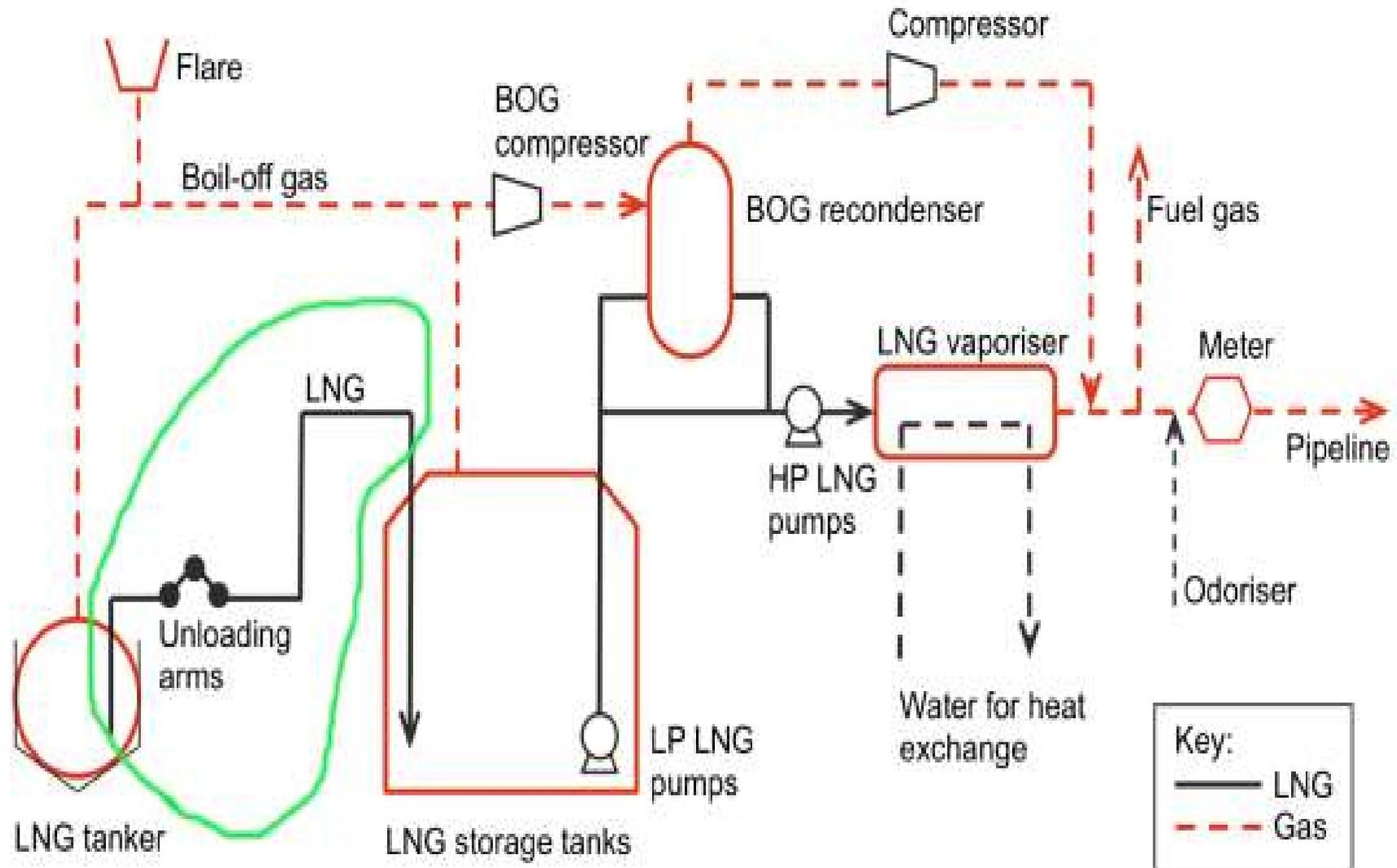
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# Receiving Terminal in LNG Value Chain



# Basic Process of LNG Receiving Terminal



# Systems of LNG Terminal

## 1. Unloading Systems

- Unloading Arm
- Loading / Return Gas Arm

## 2. LNG Storage Systems

- LNG Storage Tank

## 3. BOG Treatment Systems

- BOG Compressor
- BOG Re-condenser

## 4. Offloading Systems

- Low Pressure LNG In-tank Pump
- High Pressure LNG Pump

## 5. LNG Regasification Systems

- Low Pressure LNG Vaporizer
- High Pressure LNG Vaporizer

## 6. Metering Systems

- Export Gas Metering Station

## 7. Flare Systems

- Flare Stack

# Systems of LNG Terminal

## 8. Seawater Systems

- Seawater Pump
- Screen

## 9. Service and Potable Water Systems

- Sea Water Storage Tank
- Sea Water Pump
- Potable Water Storage Tank
- Potable Water Water Pump

## 10. Service and Instrument Air Systems

- Air Compressor Package
- Dryer Package

## 11. Nitrogen Systems

- Nitrogen facilities

## 12. Waste Water Treatment Systems

- Waste Water Treatment Package

## 13. Power Generation Systems

- Captive Power Plant
- Emergency Diesel Generator

## 14. Fire Fighting Systems

- Diesel Driven Pump
- Electrical Driven Pump
- Jockey Water Pump

# LNG Unloading Systems (LUS)

The Systems which is used to transfer LNG from LNG Carrier to Terminal Storage is called LNG Unloading Systems.

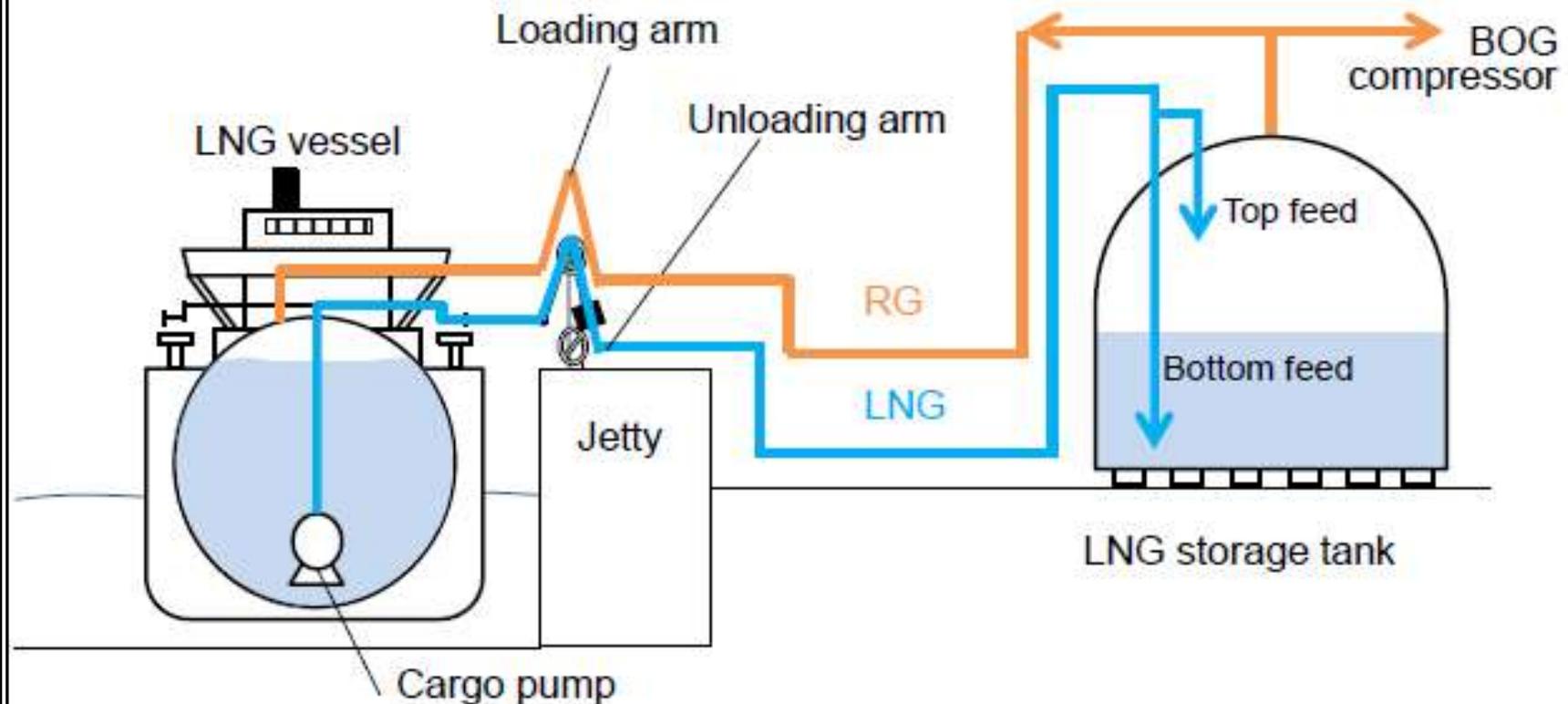
Along with other operational & Controlling Systems, it has more than one Unloading Arms and at least one Loading / Return Gas Arm.



Fig : LNG Unloading Systems

# Mechanism of LNG Unloading

- LNG: LNG vessel → Unloading arm → LNG storage
- BOG: LNG storage → Loading arm → LNG vessel



# Interface between Vessel and Shore side

Manifold on LNG vessel



Source: Tokyo Gas

LNG Vessel



# Interface between Vessel and Shore side

## LNG Unloading Arms on Platform



# Ship/Shore compatibility study

It is necessary to make sure whether or not terminal can berth an LNG carrier which has never come to the terminal before.

## Confirmation of compatibility between ship/shore

- **Arm connection compatibility**
- **Gang way connection compatibility**
- **Fender contact condition**
- **Connecting cable specification**
- **ESD functional specification, etc.**

## Calculation of mooring force (by ship)

## Berthing energy calculation (by shore side)

## Preparation of necessary emergency contact system and so on

# Berthing Standards of LNG carriers

(for Sodegaura Terminal, Japan)

Vessel Class	Av. Wind Speed	Docking Speed	Tugboat	
			Horse power	Quantity
150 K m <sup>3</sup> or more	10 m/s or More	10 cm/s or Less	3,600 Hp or more	4 tugs (5 tugs shall be used when there is an off-shore/on-shore wind on the stern side and the tide is 0.5kt)
177 K m <sup>3</sup> or less	Under 10 m/s		3,100 Hp or more	4 tugs
Under 150 K m <sup>3</sup>	12 m/s or less		~3,000 Hp or more	4 tugs

# General procedure of LNG unloading

1. Pilot on Board (POB)

2. Berthing

3. Mooring

4. Fitting Gangway, Connecting Arms & Cables

5. Joint Inspection

6. Pre Discharge Meeting

7. Initial Gauging

8. Emergency Shutdown Device (ESD) Test

# General procedure of LNG unloading

9. Cool Down/Chilling Unloading Arms

10. Starting First Cargo Pump

11. Sampling

12. Stopping All Cargo Pumps

13. Liquid Line Purge

14. Final Gauging

15. Disconnecting Arms, Cables and Gangway

16. Departure

# General procedure of LNG unloading



**NEXT**

# Parts of Unloading Systems

**Jetty**

**Platform**

**Dolphins (Breasting & Mooring)**

**Fenders**

**Quick Release Hooks**

**Piping & Cables**

**Berthing & Monitoring Systems**

**LNG Unloading Arms**

# Berthing & Mooring Systems

## Berthing :

- Once the ship is positioned in front of the jetty head, two laser transceivers will **monitor its movement**. They inform in real time the pilot about speed and direction of the stern and the bow of the ship by means of a pager system and a large display screen. This system is called **Berthing Aid Systems (BAS)**.

## Mooring :

- The Ship's Master using the **Mooring load Monitoring Systems ( MLMS)** installed on the LNG jetty, ensure that his vessel remains **securely moored at all times**.

# Outline of Unloading Arms

## LNG Unloading Arms

- Facility for loading LNG from LNG carrier
- Flexible to accommodate any movement
- Hydraulically operated
- Two to five arms are installed
- Made of Stainless steel

# Types of Unloading Arms

## FBMA:

- Fully Balanced Marine Arm

## DCMA :

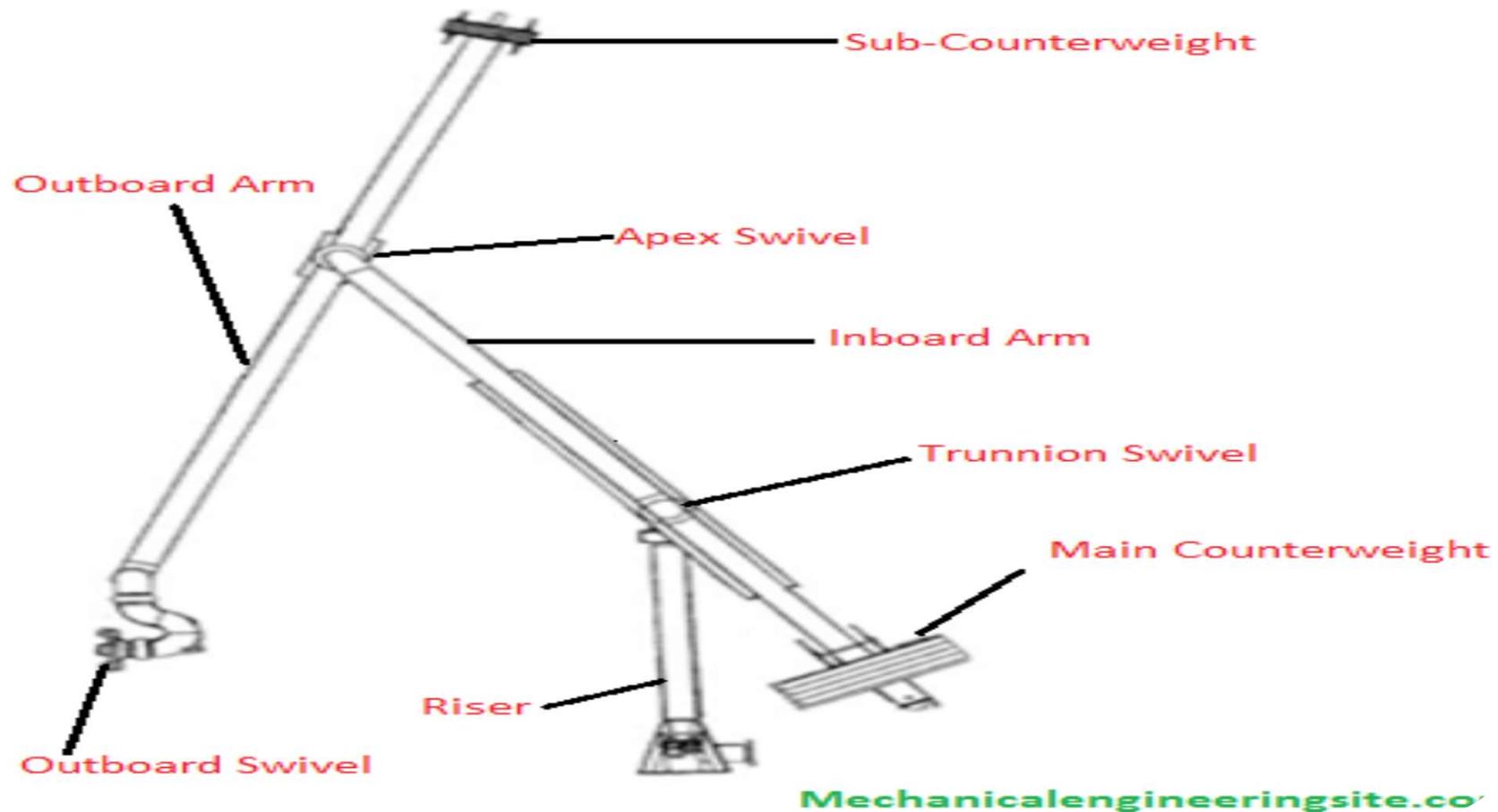
- Double Counterweight Marine Arm

## RCMA :

- Rotary Counterweight Marine Arm

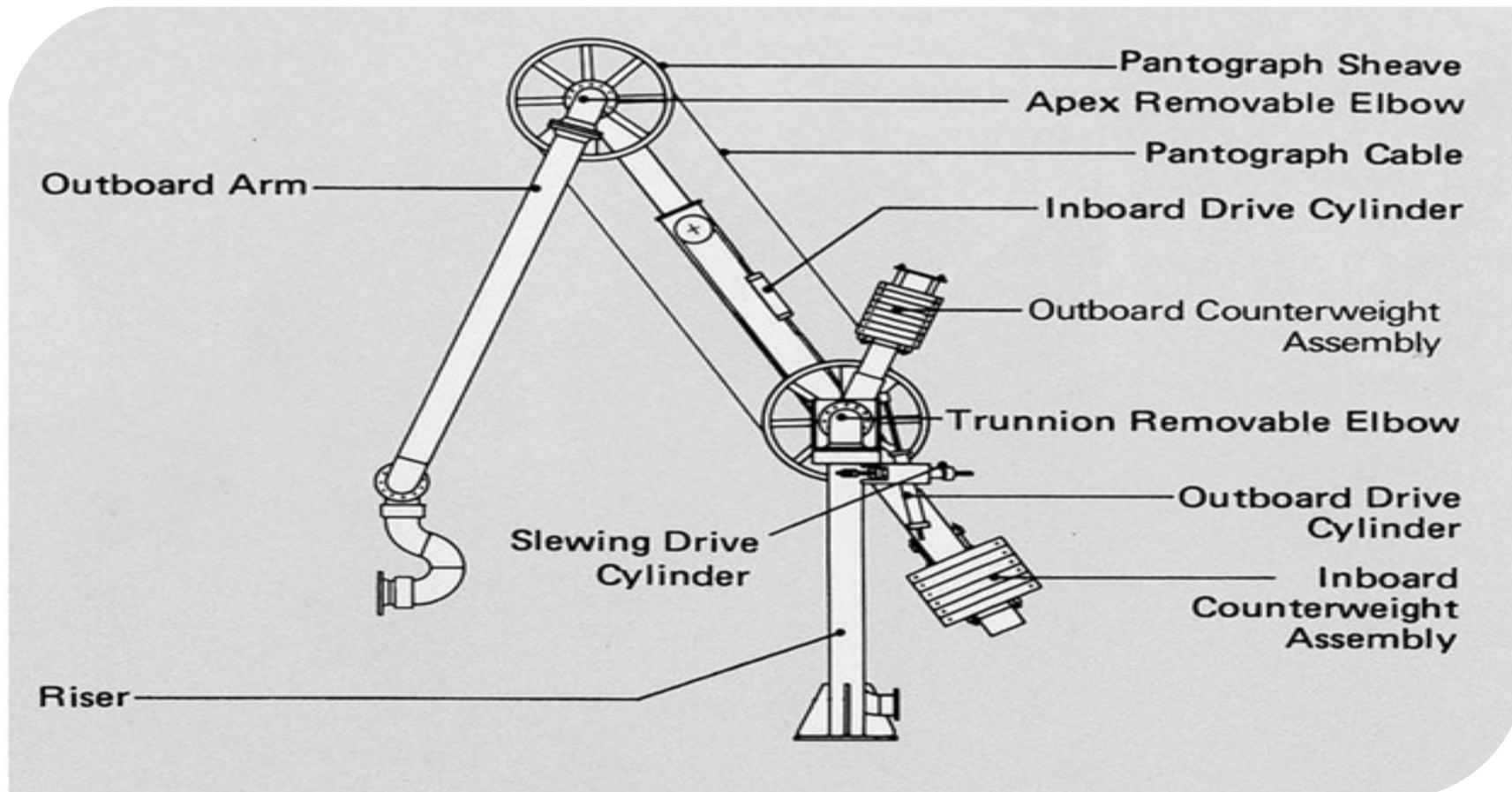
# Type of Unloading Arms

## FBMA (Fully Balanced Marine Arm)



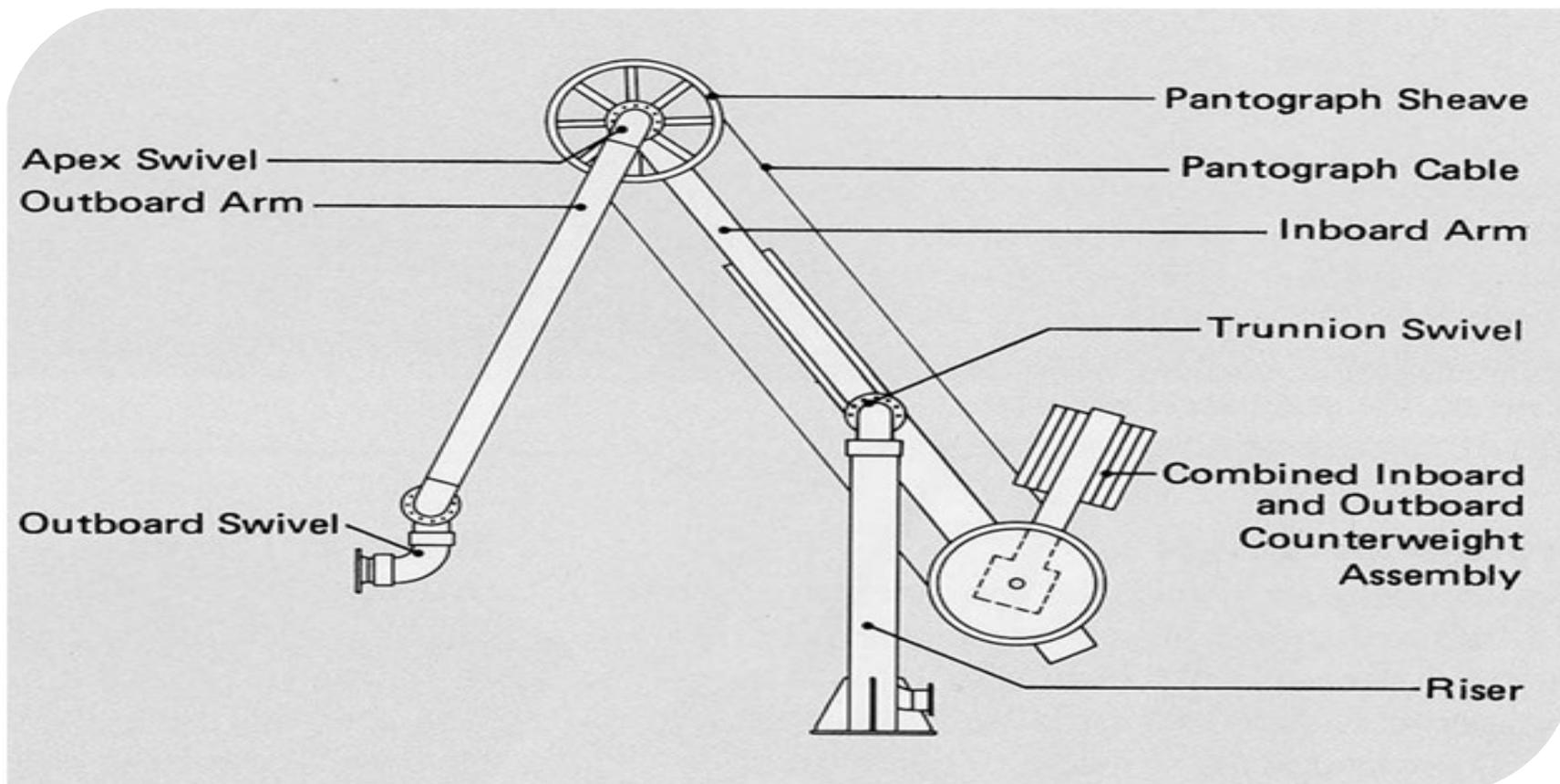
# Type of Unloading Arms

## DCMA (Double Counterweight Marine Arm )



# Type of Unloading Arms

## RCMA (Rotary Counterweight Marine Arm )



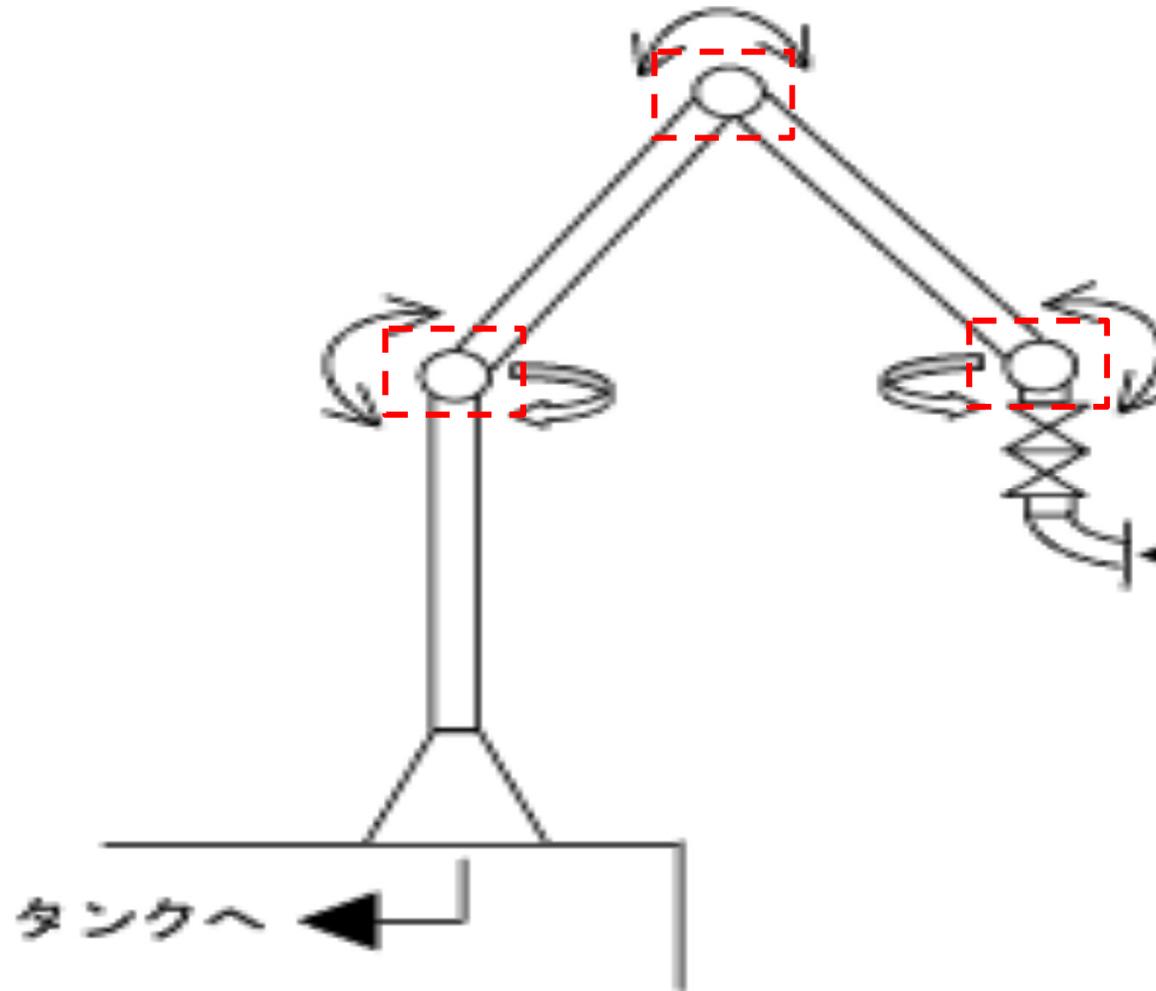
# Main Parts of Unloading Arms

- Swivel Joint
- Radio Control
- Power Emergency Release System (PERS)
  - Two ball valves
  - Emergency Release Coupler
  - Hydraulic/Electric control system
- Quick Connect/Disconnect Couplers (QCDC)
- Position Monitoring System (PMS)
- Emergency Shutdown Device (ESD)

# Description of Main Parts UA

## Swivel Joint

- 360° Rotation with ball bearing
- High mechanical strength
- Prevent liquid leakage



# Description of Main Parts UA

## Radio Control

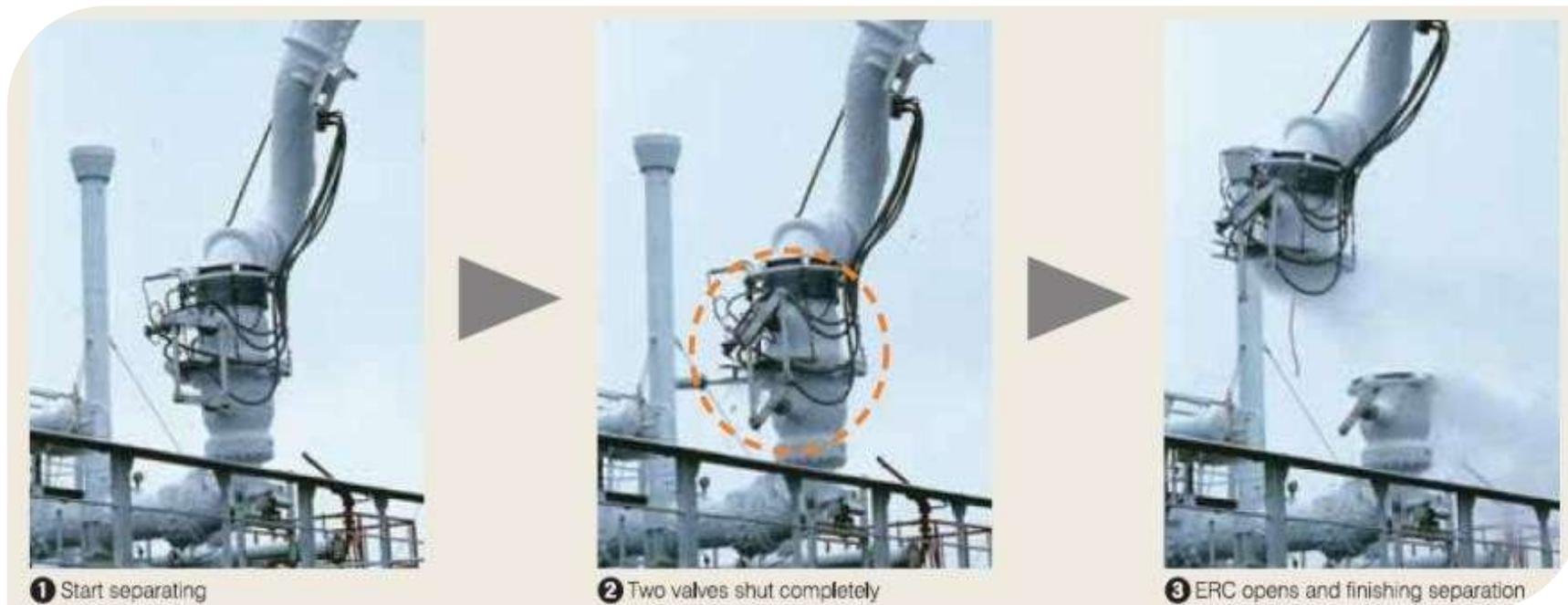
- Compact and light weight
- Control unloading arms from anywhere
- Arm selection and Flanging operation



# Description of Main Parts UA

## Power Emergency Release System (PERS)

- Protect both the ship's manifold connection and the terminal's hard arms.
- Allows the rapid disconnection of the LNG carrier from the terminal while limiting the amount of LNG released.
- Comprised of two ball valves, an emergency release coupler & Hydraulic/Electric control system.



# PERC in Action

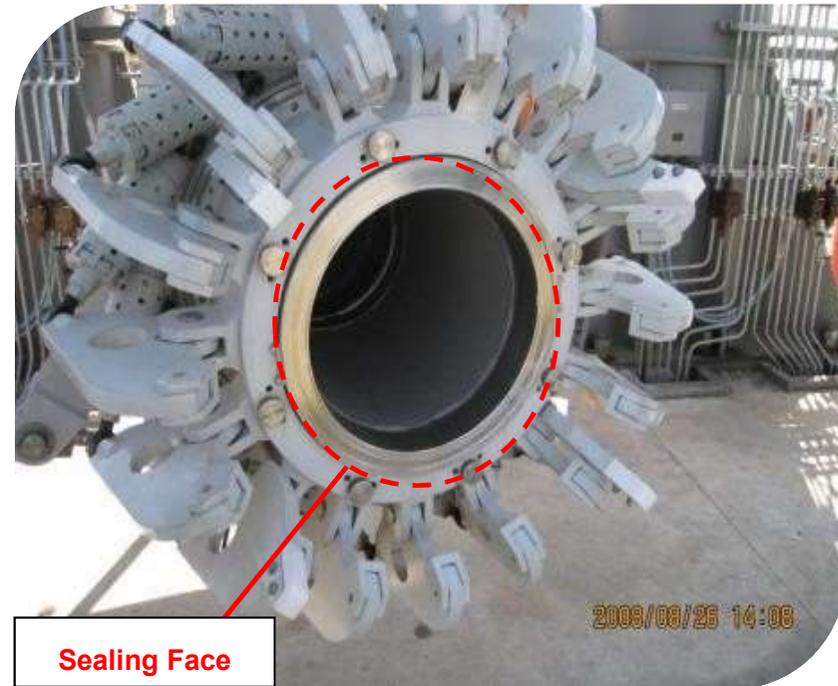
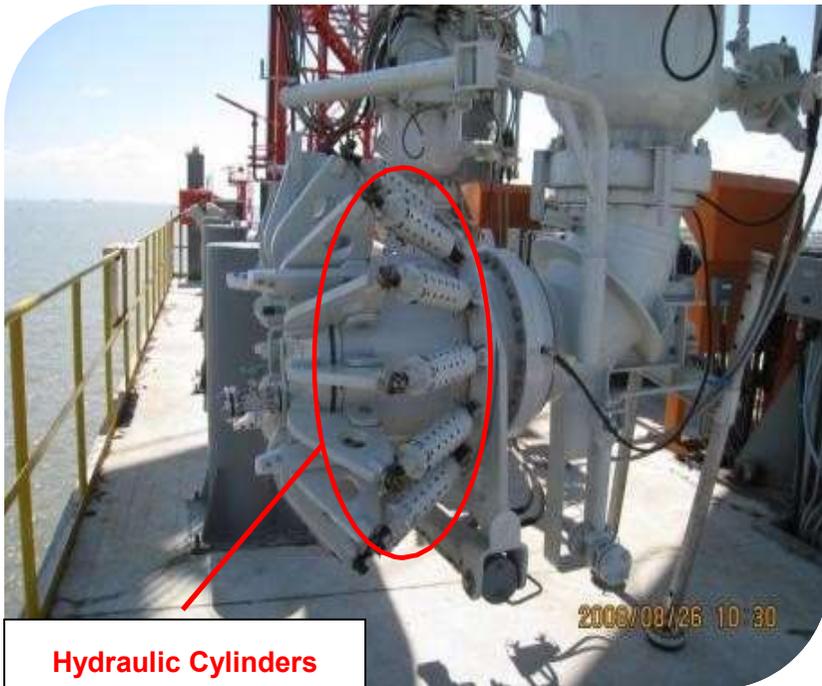


**NEXT**

# Description of Main Parts UA

## Quick Connect/ Disconnect Couplers (QCDC)

- Quick and easy method to Connect & Disconnect unloading arm to the LNG carrier manifold.
- Hydraulically operated and can be adaptable to various sizes of manifold flange

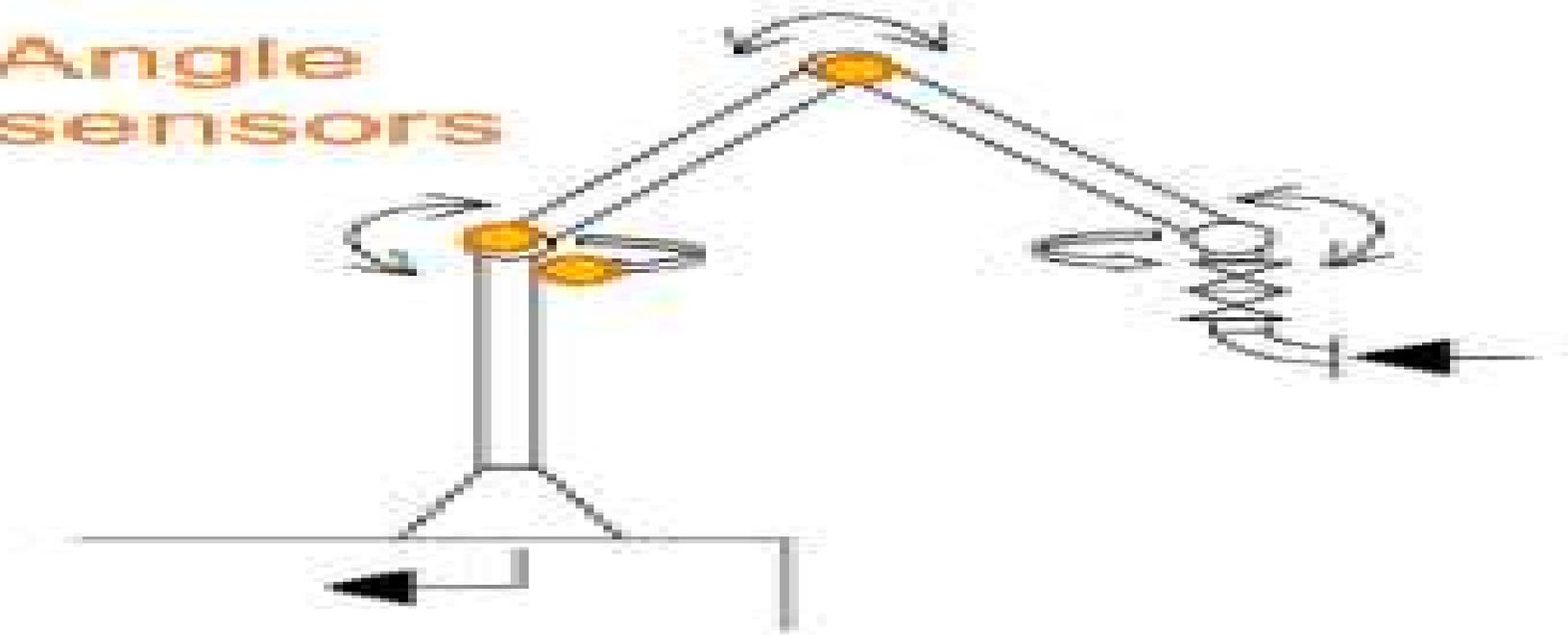


# Description of Main Parts UA

## Position Monitoring System (PMS)

- Angle sensors are attached on Loading arms (The signals are transmitted to PMS through CPU).
- Continuously monitor the condition & location
- Visually display the position & drifting speed

Angle sensors



# Description of Main Parts UA

## Emergency Shutdown Device (ESD)

- **System to disconnect unloading arms from the LNG carrier**
- **Layer of protection mitigate a hazardous situation from occurring**

### Shut Down Level Hierarchy

Level	Cause (Trigger)	Effect (Consequence)
ESD -1	<ul style="list-style-type: none"><li>▪ Power Failure</li><li>▪ Ship over-movement (step 1)</li><li>▪ LNG tank level High Etc.</li></ul>	<ul style="list-style-type: none"><li>▪ Cargo pumps shut down</li><li>▪ Closure of ESD valve on each unloading line at jetty head</li></ul>
ESD -2	<ul style="list-style-type: none"><li>▪ Ship over-movement (step 2)</li></ul>	<ul style="list-style-type: none"><li>▪ Activation of ESD-1</li><li>▪ Closure of DBV on each unloading arm</li><li>▪ Arm disconnection</li></ul>

# Time Management in LNG Unloading

## Cargo Unloading

- LNG shall be unloaded in full cargo lots.
- Terminal shall issue a Certificate of volume unloaded.

## Notifications of Estimated Time of Arrival (ETA)

- The Toller shall inform the Terminal about "ETA" .

## Notice of Readiness

- Just after the LNG Tanker arrived at the Pilot Boarding Station the Master shall give Notice of Readiness (NOR) to the Terminal.

## Unloading Time

- Allotted Unloading Time (ALUT): 36 hours from NOR.
- Actual Unloading Time (ACUT) : Ready To Unload - Delivery of Cargo Papers.

## Demurrage

- In case ACUT exceeds ALUT because of Terminal, they shall pay to the Toller demurrage.

## Repairs

- The Toller may be allowed to repair the LNG Tankers with the consent of the Terminal.
- The Toller shall make sure that the LNG Tanker can leave the Terminal under its own power or assisted with tugboat if needed in an emergency.

# Corrosion and Corrosion Management

## Corrosion

- **Corrosion** is the deterioration of a material (usually metal) as a result of chemical and/or electrochemical reaction with their environment.

## Forms of Corrosion

- Uniform Attack /Surface Corrosion
- Galvanic or Two-Metal Corrosion
- Crevice Corrosion
- Pitting
- Inter granular Corrosion
- Selective leaching
- Erosion Corrosion
- Stress-corrosion cracking

# Corrosion and Corrosion Management

## Uniform Attack /Surface Corrosion

- Corrosion which proceeds uniformly over the entire exposed surface or over a large area. The metal becomes thinner and eventually fails.

## Crevice Corrosion

- The small space where the chlorine or other corrosive anion can be condensed shall often be corroded.
- The passive state membrane of Stainless steel or other metallic material could be destroyed.

## SCC (Stress Corrosion Cracking)

- The phenomenon that cracking of metallic material is generated mainly along with the grain boundary under the condition of high tensile stress in corrosive environment

# Basic Policy for Maintenance

## Ensuring Safety and Security

- Determining clear Management **Standards** for work
- Ensuring thorough **Compliance** with those Standards
- Enhance Safety Awareness through **Training**

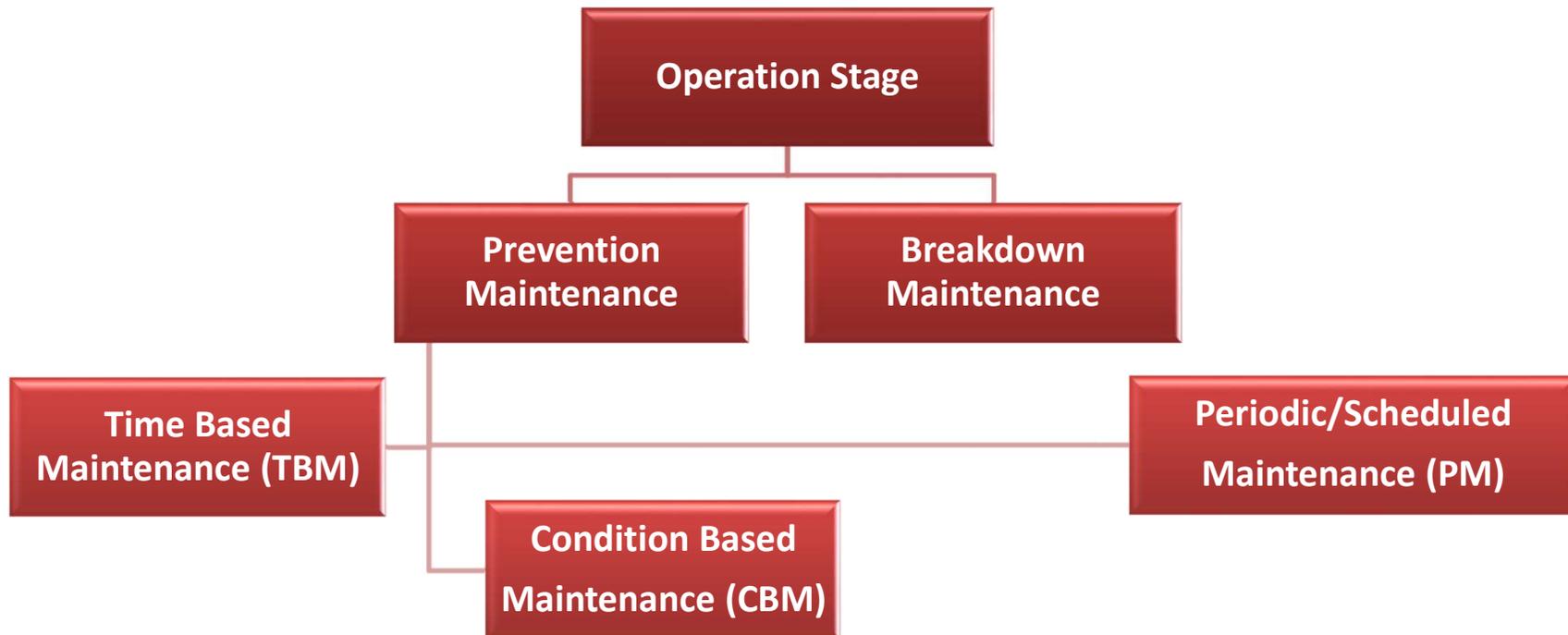
## Cost reduction

- Selecting proper quality & quantity of **Skilled people**
- Identifying the necessary works which results in **Longest Possible Maintenance Intervals**
- Applying **Wisdom and Ideas** at the stage when work is being planned

## Maintenance Management

- Maintenance methods differ on the basis of **Importance of the Equipment** or whether it has **Back-Up Units** or not
- Condition Based Maintenance (CBM), Time Based Maintenance (TBM), Periodic Maintenance (PM) or Break down Maintenance (BM)

# Maintenance Management



# Maintenance Management

## Preventive Maintenance

- Periodical inspection is carried out to prevent any failures and to maintain functions.
- Repair or spare parts replacement takes place before failures or loss of functions.

## Breakdown Maintenance (BM)

- Repair and replacement are carried out after facilities failure or deterioration.
- Shutdown is subject to a long downtime.

# Maintenance Classification

## Daily checks (DC)

- Patrols by operation divisions check that the equipment is not exhibiting any abnormalities

## Periodic checks (PC)

- The maintenance divisions make quantitative checks for equipment deterioration, damage, etc. in order to maintain functionality

## Overhaul maintenance (OM)

- For periodic maintenance, the maintenance divisions shut down operation or take the units that comprise the offline for inspection.

# Maintenance of Unloading Arms

Periodic checks  
(once a year)

- **Visual inspection of exterior of all sections**
- **Greasing of rotating rings**
- **Bolt torque checks**
- **Wire measurements**
- **Measurement of insulation resistance at joints,**
- **Deterioration in hydraulic fluid**
- **Touch-up painting**
- **Leak test**
- **ERS test**

# Maintenance of Unloading Arms



# Maintenance of Unloading Arms

**Overhaul maintenance  
(once every 10 years)**

- **Oil tube replacement**
- **Re-coating**
- **Cylinder overhaul**
- **Swivel Joint seal replacement**
- **Leak test**
- **Measuring thickness**
- **Measuring deflection**
- **PT**

# Maintenance of Berthing/Mooring

## Periodic checks

### Quick Release Hooks :

- Daily checks (on LNG ship arrival)
- Visual inspection check of functionality greasing(once every 3 months)

### Fenders :

- Damage and corrosion check (once a year)
- Measurement of residual thickness of fender top (once every 3 years)
- Rubber deterioration measurement (once every 10 years)

### Steel tube piling :

- Check the corrosion Status of Steel tube piling

# Maintenance of Berthing/Mooring

## Periodic checks

### Oil Fences :

- Check the Fences (once a year)

### Shield tunnel :

- Check for lining on surface of inner tunnel (once a year)

### Bathymetry :

- Check for the depth of the seabed (once a year)

# Maintenance of Berthing/Mooring

## Examples



**THANKS**